GUIDE TO USING THE MONTANA DEPARTMENT OF AGRICULTURE CROP & ROTATION MODELING SPREADSHEET

Developed by: Chad Lee, Montana Department of Agriculture
February 2012

Disclaimer:

The Montana Department of Agriculture and its staff are not responsible for:

- Decisions made by parties as a result of using of this spreadsheet or the outcome of those decisions,
- errors within the spreadsheet,
- the reasonableness of original estimates and sample rotations contained in the spreadsheet, or
- the outcome of decisions made by parties who use the spreadsheet as a decision tool after making alterations to the spreadsheet.

The Montana Department of Agriculture provides no assurance that the crops listed in the spreadsheets can be successfully grown in all areas of Montana or elsewhere.

The Montana Department of Agriculture made considerable efforts in designing and testing the spreadsheet, and measures were taken to prevent accidental alteration of formulas. Spreadsheet users should adjust the assumptions and rotation information to be applicable to their farm and check for errors before making any decisions. Ultimately, spreadsheet users are responsible for their own decisions. Spreadsheet users should avoid changing formulas, but if it is necessary to change formulas, take extreme caution.

Purpose

The Montana Department of Agriculture created the crop and rotation modeling spreadsheet to serve as a tool for farmers to compare the economics of different crops and rotations. The spreadsheet allows users to design and compare up to eight rotations. The duration of the rotations can be up to 15 years long. For each crop/year, the user selects field operations to be performed. Up to 15 field operations can be entered for each crop/year. Selected field operations are used to calculate fuel and lubrication costs and to determine time/labor requirements for comparison and planning purposes. Spreadsheet users can use this information to consider the impacts of operations on moisture and to consider equipment needs as it pertains to the timing and synchronization of field operations.

An effort was made to develop reasonable estimates for the 2012 crop year (as of February 2012). Many of these estimates came from or were influenced by projections made by North Dakota State University for Northwestern North Dakota. The default yield assumptions for dryland production are based on averages from region-wide average yields in recent years, with a few exceptions. Default yield assumptions for irrigated production are based on typical or estimated yields for irrigated cropland at different locations and therefore need to be scrutinized more closely to ensure applicability and consider suitability and marketability of a given crop in a given location. Users can *(and should)* change these assumptions and estimates to make the spreadsheet calculations applicable to their farm and growing conditions and to reflect their expectations for future years.

General Instructions:

When using the spreadsheet, only modify or enter information in cells with a yellow background in the following worksheets: "Assumptions", "All Crops", "Rotation Summary", and "Rotation 1" through "Rotation 8".

Information has already been entered in the yellow spreadsheet cells based on crop and input price levels projected for 2012. The information entered is derived from a number of sources, including projections made by North Dakota State University for Northwestern North Dakota *(See Documentation of Original Estimates Entered in Assumptions Worksheet)*. This information can *(and should)* be changed to match the production history and conditions of the farm being evaluated. Spreadsheet users should consider whether the default values reflect their expectations for the future.

It is recommended that users work through the spreadsheet in the order of the worksheets.

- The Assumptions Worksheet is a centralized location where assumptions for price, yield, and costs are entered for crops on a per-acre basis.
- The All Crops Worksheet is focused on comparing the profitability of individual crops and is for the shortest decision-making timeframe.
- The Rotation Worksheets are where the spreadsheet user designs individual rotations. These spreadsheets can be used by farmers already in set rotations to evaluate 2012 average direct returns, or it can be used by farmers considering adapting different rotations over a longer period of time.
    - Information can be entered for up to eight rotations.
    - When a crop is selected for a year in the rotation, the spreadsheet uses information from the Assumptions Worksheet to calculate revenue and expenses.
    - The Rotation Worksheets are designed with some flexibility to allow spreadsheet users to add some expenses that may be specific to the farm, crop, or field for each individual year in the rotation. For example, if raising a particular crop requires the farm to rent an implement or hire a custom operator to complete a field operation, the cost can be entered on a $/acre basis.
    - The Rotation Worksheets also allow spreadsheet users to specify the field operations that will be performed in individual years. The spreadsheet uses this information to calculate the fuel cost and direct labor requirements for field work (hours/acre).
    - Charts elsewhere in the spreadsheet display and compare the results of calculations made in each Rotation Worksheet.

Yellow Spreadsheet Cells

Information should be entered or changed only in spreadsheet cells with a yellow background. The yellow spreadsheet cells are for variables. The spreadsheet performs calculations in other cells, based on the entries in the yellow cells. Altering cells with a white background will change formulas, which will likely cause calculations to be in error, significantly impacting analysis results.

Many of the spreadsheet cells that contain formulas have a white background and are "locked". Additionally, some cells and worksheets are hidden to help prevent accidental changes to

formulas and to avoid confusing spreadsheet users. If the user finds it necessary to change or unhide cells, the individual sheet must be unlocked using the following menu sequence:

- For older versions of Excel: Tools – Protection – Unprotect Sheet – Password: press the Return or Enter key
- For Excel 2010: Review – Unprotect Sheet – Password: press the Return or Enter key

To look for hidden cells, look at the row number for gaps, highlight the rows on either side of the gap, right click, and choose Unhide. To look for hidden sheets: Format – Sheets – Unhide – select sheet to unhide.

Drop-down Boxes

Drop-down boxes are used to restrict the entries that can be made in the Rotation Worksheets (Rotation 1 – Rotation 8) and the All Crops Worksheet. Drop-down boxes are used to restrict:

- selection of crops for each year in the rotation
- selection of field operations for each year in the rotation

All drop-down boxes have the option to select a blank entry if no selection is desired; the only way to select a blank entry is by using the drop-down box. If the Rotation Worksheet has information entered into more years than is desired for a rotation, blank entries should be selected for that year's crop and field operations.

Navigating the Spreadsheet:

WORKSHEETS ***(in order)***	**EXPLANATION & INSTRUCTIONS**
Disclaimer	Liability disclaimer
Assumptions	The majority of adjustable spreadsheet variables are located in the Assumptions Worksheet (yellow spreadsheet cells). Adjustable variables exist for crop, commodity market price, yield, seed cost, herbicide cost, fungicide cost, insecticide cost, crop insurance cost, fertilizer application rate and cost, nitrogen credits for legume crops, fuel and lubrication cost, field operation fuel consumption, off-farm commodity trucking cost, irrigation costs, operating interest cost, net present value discount rate, and machinery capacity (for field operation time requirements). Fertilizer application rates are based on nutrient replacement rates for target yields that are entered separately from anticipated harvested yields. The default target yields are set to be the same as the anticipated harvested yields. If users change the anticipated harvested yields significantly (up or down), they should adjust the target yield used to calculate fertilizer costs. Application rates of N, P, K, and S can be further adjusted for individual crops to factor in soil test analyses or factor in the cost of additional N applied to pursue protein goals in wheat production.

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
All Crops	This worksheet includes a chart showing the direct returns of each crop and has graphical features that allow users to vary key revenue and cost variables and immediately see the economic impact on the chart. Buttons allow users to change critical variables in crop profitability, including the price and yields of each crop, fertilizer component prices (N, P, K, S) costs, and the number of applications of fungicide on pulse crops and safflower. Individual components of revenue and direct costs can be viewed below the chart and key variable adjustment buttons. The field operations are set below the direct return calculations.
Crop Comparison *(Chart)*	Compares return after direct costs for selected crops.
Rotation 1 Rotation 2 Rotation 3 Rotation 4 Rotation 5 Rotation 6 Rotation 7 Rotation 8	These worksheets allow users to design up to eight rotations. In each worksheet: • Use drop-down boxes to select the **crop** to be grown each year to establish the sequence of the rotation (up to 15 years in length). o Select blank entries for years not under consideration. o Enter information so that cycle of a rotation is complete. (*For example, if the rotation is winter wheat – chem. fallow, the following should be entered: Yr1 – Winter Wheat, Yr2 – Chem Fallow*). • Use drop-down boxes to select the **field operations** to be performed for each year in the rotation (up to 15 operations per crop/year). o Select blank entries for years not under consideration. • The yield, commodity price, direct costs, and return (after direct costs) are shown for each crop/year in the rotation. • The **Rotation Benefit - Yield Adjustment Factor** increases or decreases the yield of a particular year (*relative to the yield entered in the Assumptions page for a given crop*) to allow spreadsheet users to make adjustments to reflect changes in yield related to crop rotation. For example incorporating pulse crops or oilseed crops into a rotation will likely improve the yield of the following cereal crop. A yield adjustment factor of 100% results in no change, 200% doubles the yield, 50% reduces the yield by half.

Navigating the Spreadsheet:

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
Rotation 1 Rotation 2 Rotation 3 Rotation 4 Rotation 5 Rotation 6 Rotation 7 Rotation 8 *(continued)*	• The **Rotation Quality Benefit - Price Adjustment Factor** increases or decreases the crop price for a particular year (*relative to the price entered in the Assumptions page for a given crop*) to allow spreadsheet users to make adjustments to reflect changes in quality (related to crop rotation) that impact price. For example, incorporating pulse crops into a rotation may improve the protein of the following wheat crop resulting in a protein price premium. A price adjustment factor of 100% results in no change, 200% doubles the price, 50% reduces the price by half. • Adjustable variables **Land Rent, Custom Hire (Contracted Field Operations), Machine Rent, Direct Labor, and Other Direct Costs** allow spreadsheet users to enter additional direct costs that may apply to the crop/year. o For purposes of comparison, these costs only matter if there is a difference in these costs between crops or rotations. • The spreadsheet calculates a legume crop fertilizer credit in the year the crop is grown. The legume crop fertilizer credit appears in the spreadsheet as a "negative expense" (income). As such, this is a non-cash benefit that is not realized until future years, but is attributed to the legume crop. The spreadsheets allow nitrogen fertilizer credits for pea and lentil crops, peas that are terminated before maturity (plowdown), cover crops, soybeans, and for alfalfa (in the last year of a stand). The amount of credit is based on the value of the nitrogen fixed. o To reflect that some growers do not reduce nitrogen fertilizer application following pulse crops, but do benefit from increased yield or improved protein content in the following wheat crop resulting in improved prices, the default nitrogen credit amounts in the Assumptions Worksheet were set to 0 lbs of N per acre. ▪ *In the default rotations, adjustments were made following pulse crops and oilseed crops that reflect a yield kick for the following cereal crop. Additionally, adjustments were made following pulse crops for a protein price premium for the following wheat crop for improved protein..* o If spreadsheet users want to assign values for nitrogen fixation, the credit amounts (lbs of N/acre) should be changed in the Assumptions Worksheet. ▪ *If nitrogen credit amounts are restored in the Assumptions worksheet, the adjustment settings in the default rotations for rotation yield and price benefits should probably be returned to 100% for the cereal crops following pulse and oilseed crops.* ▪ Previous versions of this spreadsheet had default nitrogen credit values as follows: 10 lbs N/acre for peas and lentils, 20 lbs N/acre for pulse plowdown crops, 15 lbs N/acre for generic cover crops, 100 lbs N/acre for terminated alfalfa.

Navigating the Spreadsheet:

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
Rotation 1 Rotation 2 Rotation 3 Rotation 4 Rotation 5 Rotation 6 Rotation 7 Rotation 8 *(continued)*	Rotation Summary Calculation: Average annual return after direct costs for the rotation. Direct labor requirements for field operations (hours/acre) for each crop/year for the selected field operations. Diesel consumption (gal/acre)for the selected field operations
Rotation Summary	• Summarizes the average annual returns (after direct costs) for rotations. • Lists the crop sequence designed for each rotation. • Rotation names can be entered in cells B6:B13, which affects the rotation names showed in the chart Rotation Comparison 1. • Information presented in crop comparison charts and rotation comparison charts is gathered from the Rotation Summary worksheet. o If users want to change chart axis labels, these changes have to be made in the Rotation Summary Worksheet.
Rotation Comparison 1 *(Chart)*	• Compares average annual returns of rotations. X-axis labels are user-defined names established in Rotation Summary worksheet cells B6:B13. o If crop rotations are changed, the labels on the Rotation Summary page need to be updated.
Rotation Comparison 2 *(Chart)*	• Compares average annual returns of rotations. Labels are set to "Rotation 1" – "Rotation 8".
Rotation Charts (1-4 & 5-8)	• Provide graphs for each rotation showing the year-to-year return after direct costs. • Shows average annual return after direct costs for each rotation

Key Comparisons

- ***Crop Comparisons***: In spreadsheets that compare the economics of different crops, ***the comparison is the "return after direct costs" per acre***. Return after direct costs is a measure that does not include all sources of income or all costs. Instead the measure attempts to narrow and simplify comparisons to relevant differences between crops and rotations. This measure excludes the economic impact of rotation benefits achievable through crop diversification with pulse and oilseed crops.
    - This comparison does not take into account other farm income streams such as government payment revenue, custom farming revenue, or land easement rents and royalties (for conservation, wind energy, or oil and gas production).
        - It is acknowledged that government payment programs (such as the ACRE program and CSP program) may be important considerations in crop and rotation selection.
        - The crop and rotation spreadsheets have the ability to enter crop insurance policy information that factors in crop insurance revenue for yield insurance and revenue insurance. Revenue insurance is not available for all crops.
            - For crops in which revenue insurance is available, users need to choose whether to enter policy information for yield insurance or revenue insurance in the Assumptions worksheet.
                - Entering information into both will potentially result in error.
                    - The formulas used to determine crop insurance revenue chose whichever indemnity payment is greater.
                    - Because farmers must sign up for only one policy type for a field, one of the two policy types should be blank or have a zero value.
    - This comparison also does not take into account fixed costs (such as labor and depreciation), land costs *(for which there only would be a difference if the land was rented on a crop-share basis)*, or certain indirect overhead costs such as repairs or liability insurance that may be difficult to allocate to a particular field or crop. Many of these costs will be incurred regardless of, and independent of, crop and rotation selection and therefore are not relevant to the comparison.
        - Flexibility exists within the spreadsheet to allow some of these types of costs to be added, if indeed these costs can be accurately allocated or if there will be additional costs identifiable to a particular crop or rotation.
- ***Rotation Comparisons***: Rotations are compared by the following measure: ***average annual return after direct costs per acre*** (for the duration of the rotation).

Documentation of Original Estimates Entered in Assumptions Worksheet:

Many of the "default" estimates entered into the Assumptions Worksheet are "localized" for certain regions of Montana. Users should adjust these estimates to reflect their own conditions, circumstances, and expectations of the future.

Source of Information for Crop Yields:

- Most of the yields entered into dryland versions of the spreadsheet are region-wide average yields (for the 2004 – 2008 period) in USDA National Agriculture Statistics Service (NASS) statistical regions.
    - Exceptions to this include yields for yellow peas, lentils, chickpeas, canola, and flax.
        - The yellow pea yield was adjusted to be higher than the green pea yield.
        - Lentil yields were adjusted to yields more similar to the state average, with some variation added to reflect that different classes of lentils will yield differently.
        - Chickpea yields were adjusted to yields more similar to state average yields, with some variation added to reflect that different classes of chickpeas may yield differently. Dryland chickpea yields may vary widely and have the potential to be substantially higher that the default yields entered. Besides moisture, a major factor influencing chickpea yields is disease, particularly ascochyta blight. Some of this risk can be attenuated by variety selection, seed testing, seed treatment, frequent field scouting, and prompt treatment of disease outbreaks with fungicide. Chickpeas are much more tolerant to hot growing conditions than peas and lentils.
        - The canola yield was adjusted to be similar to the state average. Modern hybrid varieties have the potential to yield substantially higher than the state average, given adequate soil moisture, absence of excessive heat at critical growth stages, and adequate nutrient availability.
        - The flax yield was adjusted to be similar to the state average.
    - For the dryland versions of the spreadsheet, default yield data entered in the Assumptions is derived from non-irrigated production statistics (to the extent possible). For major cereal crops, NASS previously published more detailed county-wide statistics for non-irrigated acreages: non-irrigated fields *following summer fallow* and non-irrigated fields *under continuous crop management*. The Assumptions Worksheet utilizes this detailed information for cereal grain yield assumptions.
    - NASS does not publish yield data (or necessarily collect data) on every crop and related management practice for every county, every single year. This is a function of both farmers' planting decisions and NASS's statistics collection decisions and information disclosure policy.
- Default yield assumptions for irrigated production are based on typical or estimated yields for irrigated cropland in certain production areas. Irrigated yields of certain crops may vary widely, and certain areas are not suited for growing some of the crops shown in the spreadsheet. Little information is available on historic yields for irrigated lentils and chickpeas, the default yields are estimates; actual yields may vary significantly. NASS

stopped publishing production statistics for irrigated cereal crops and alfalfa after 2009. Until recently, NASS webpages and Quick Stats showed 2009 county-level production statistics for cereal crops and alfalfa. This leaves 2008 as the last year for which NASS production statistics are available for irrigated cereal crops and alfalfa.

Crop Prices:

- The crop prices entered into the spreadsheet are estimates made as of mid-February 2012.
    - The market outlook at that time was one of volatility, with an anticipation of weakening demand. The level of confidence in price projection of any crop was moderate to low, unless favorable production contracts were in place to substantially offset price volatility risk. For example, much of the 2012 malting barley crop was contracted in the fall of 2011 at very favorable prices.
    - For 2012, a range of prices are possible for every crop. The Assumption Worksheet's prices can be changed to what the user believes to be appropriate for the time horizon under consideration, factoring in portions of the crop for which prices are contracted.
- The crop prices used are based on the most common price unit used in trading the commodity ($/bushel, $/lb, $/cwt, $/ton). Barley is traded in bushels and hundredweight (cwt), which causes confusion. The spreadsheet bases the barley price on $/bushel. To convert a $/hundredweight price to $/bushel (for barley), multiply the $/hundredweight price by 0.48. Commodity test weights are presented in the section of cost assumptions that pertains to seed cost (Row 34 in the Assumptions Worksheet).
- The $6.25/bu default price for malting barley is based on contract prices available during the fall of 2011, when much of the 2012 crop was contracted. Contract prices ranged from $6 to over $7/bushel during that time period. Open market prices for the 2012 crop are likely to be noticeably lower than the contract prices offered in the fall of 2011.

Seed, Herbicide, Fungicide, and Insecticide:

- The seed costs entered into the spreadsheet (on a $/acre basis) were derived using typical seeding rates and from information presented in *Projected 2012 Crop Budgets North West North Dakota*, prepared by North Dakota State University Extension Service. http://www.ag.ndsu.edu/pubs/agecon/ecguides/nw2011.pdf The price of seed for peas was increased to reflect increased prices for yellow pea seed and the higher price of proprietary varieties of green peas sold into the Cruiser/Aragorn class market. For irrigated crops and crops not covered in the North Dakota crop budgets, other crop budget information sources, and in some cases, farmers were consulted or the cost was estimated to be the same as in 2011.
    - Users can (and should) adjust the seed price and seeding rates to levels they feel are appropriate.
- For the dryland spreadsheets, the costs entered into the spreadsheet (on a $/acre basis) for herbicide, fungicide and insecticide are derived from estimates made in *Projected 2012 Crop Budgets North West North Dakota*, prepared by North Dakota State University Extension Service.
- For irrigated crops and crops not covered in the North Dakota crop budgets, other crop budget information sources, and in some cases, farmers were consulted *or the cost was estimated to be the same as in 2011*.

- Herbicide costs may vary significantly from the estimates provided. On an individual farm, the cost of herbicides on a per-acre-basis can vary widely between fields depending on conditions and herbicide selection.
- Except of safflower and chickpeas, fungicide costs for Montana dryland crops are assumed to be zero, which is different than the northwest North Dakota projections.
    - The 2012 spreadsheet allows users to enter the number of estimated fungicide applications for pulse crops and safflower.
    - Seed testing (for disease) and seed treat are important deterrents to disease problems. If the wet conditions that existed in 2010 and 2011 persist into 2012, peas and lentils *(which usually do not experience disease issues)* may require fungicide applications beyond seed treat.
- Spreadsheet input cells are provided for users to enter the number of chem fallow herbicide applications required and the chemical cost per acre of each application.

Crop Insurance

- For Crop Insurance Revenue information input (Assumptions Worksheet Rows 23, 24, and 27) spreadsheet users should enter information for one type of insurance for each individual crop.
    - For example, if revenue coverage insurance is used for malting barley, the guaranteed revenue would be entered into the Malting Barley column intersecting with Row 27 and leave the Guaranteed Yield and Insured Price amounts blank in the Malting Barley column intersecting rows 23 & 24.
    - The default information entered assumes that if a revenue coverage policy is available for a crop that the farmer would choose it.
- In some counties in Montana, it may not be possible to insure all of the crops listed in the spreadsheet. It may not be possible to insure soybeans in Montana. If possible, individual policies might be an option for crops not listed as being insurable for a given county.
- Crop insurance guarantees and costs may vary significantly from the estimates provided. Spreadsheet users should contact their crop insurance agent to obtain accurate guaranteed yields (that reflects their production history), accurate guaranteed yields, and accurate policy costs – for the level of coverage that they will select.
- With regard to feed barley, it was presumed that the farmer planted barley with the intent of producing malt grade barley. Therefore, malting barley insurance information was used in the feed barley insurance related columns.
- The first set of 2012 crop and rotation spreadsheets were posted on the webpage prior to the release of 2012 multiperil crop insurance policy information by the USDA Risk Management Agency (USDA-RMA) at the end of February 2012. For the first set of spreadsheets, estimates were made for the guaranteed yield, insured price, guaranteed revenue (for CRC policies), and premium costs based off of what was used in the 2011 spreadsheet projections, adjusted by an estimated change in insured price for 2012.
- The second set of 2012 crop and rotation spreadsheets will posted on the webpage after 2012 multiperil crop insurance policy information is released by the USDA Risk Management Agency (USDA-RMA).
    - Information on guaranteed yield, insured price, and guaranteed revenue (for CRC policies) was obtained from USDA Risk Management Agency county actuarial

information (T-Yields) and the Cost Estimator tool were used to generate default values to enter into the spreadsheet for. The numbers used were for policies that provide 70% yield or revenue coverage.

- For the North Central Montana models, the guaranteed yields used in the spreadsheets were based on Pondera County 2012 T-Yields, except for chickpeas (Roosevelt County), flax and mustard (Valley County), sugar beets, corn, corn silage, dry beans, sunflower (Dawson County), alfalfa (for which higher yields were used), alfalfa seed (Big Horn County), potatoes (Gallatin County), and soybeans (Maclean County, North Dakota). For potatoes, a seed potato insured price was used; in eastern Montana, where potatoes might not be grown for seed, the insured price may be lower.
- For the Northeast Montana dryland and Yellowstone Valley irrigated models, the guaranteed yields used in the spreadsheets were based on Roosevelt County 2012 T-Yields, except for: winter wheat (Dawson County), flax and mustard (Valley County), sugar beets, corn, corn silage, dry beans, sunflower (Dawson County), alfalfa (for which higher yields were used), alfalfa seed (Big Horn County), potatoes (Gallatin County), and soybeans (Maclean County, North Dakota). For potatoes, a seed potato insured price was used; in eastern Montana, where potatoes might not be grown for seed, the insured price may be lower.
- For the Central Montana model, the guaranteed yields used in the spreadsheets were based on Fergus County 2012 T-Yields, except for durum (not available for Fergus County, used spring wheat yields and premiums), chickpeas (Roosevelt County), flax and mustard (Valley County).

Information Sources:

- Cost Estimator https://ewebapp.rma.usda.gov/apps/costestimator/
- Actuarial Information http://webapp.rma.usda.gov/apps/ActuarialInformationBrowser/

- The default crop insurance cost does not include hail insurance, the cost of which varies with the location of the farm and whether the policy is a private policy or purchased from the Montana State Hail Program.

Fertilizer Costs:

- Nitrogen application rates are based on recommendations made in *Fertilizer Guidelines for Montana Crops*, published by the Montana State University Extension Service in 2005.
- Nutrient uptake of phosphorus, potassium, and sulfur was calculated for each crop based on the same yields and are based on nutrient uptake estimates made in *Fertilizer Guidelines for Montana Crops*.
- The fertilizer application rate is calculated by multiplying the nutrient uptake (utilization) by target yields (which users can adjust). This number is further multiplied by a factor "Application - % of Replacement Requirement" (individually for N, P, K, and S) that allows users to increase or decrease nutrient application based on soil tests or other fertilizer application strategies.

- **Note: Target Yields are entered separately from Projected Yield**. There is no formula linking the two yields. If the Projected Yield is increased, the Target Yield should be adjusted. The two types of yields were separated to account for farmers selecting a higher target yield for fertilizer needs calculations than their expected yield.
- All "% of Replacement Requirement" factors should be adjusted to accommodate the results of soil tests.
- For the default values entered in the Assumptions, the potash (K) Application % of Replacement Requirement was set to 24% for North Central Montana and Northeastern Montana, 50% for Central Montana, and 0% for the Yellowstone River Valley to account for the reported high potash levels present in those soils.

- The Assumptions Worksheet allows for two cost levels of individual fertilizer components ($/lb of nutrient) for Nitrogen, Phosphorus, Potassium, and Sulfur: a Fall Price Level and a Spring Price Level.
  - The default "Fall" price levels are based on Fall 2011 fertilizer prices reported by the Montana Department of Agriculture Fertilizer Program.
  - The default "Spring" price levels are based on *Projected 2012 Crop Budgets North West North Dakota*, prepared by North Dakota State University Extension Service, except for the nitrogen price, which is higher and is based on a small sampling of nitrogen fertilizer prices in February 2012.
    - *The Spring price levels will be updated in March or April when spring 2012 fertilizer prices are reported by the Montana Department of Agriculture Fertilizer Program.*
- In theory, nitrogen fertilizer requirements (and cost) should be lower for crops following alfalfa, peas and lentils, and cover crops that include nitrogen fixing legumes. In some situations, soybeans may achieve a net soil nitrogen contribution, but the current view of researchers is that the benefit of soybeans to following corn crops is due to a rotational benefit, as opposed to nitrogen fixation. The spreadsheet allows for nitrogen fixation to be taken into account by reducing the direct cost of growing alfalfa, peas and lentils, cover crops, and soybeans by the estimated value of the fixed nitrogen, even though the actual cost reduction occurs after pulse crop, alfalfa, or soybean production.
  - Many growers do not reduce nitrogen fertilizer application following pulse crops, but do benefit from increased yield or improved protein content in the following wheat crop resulting in improved prices.
    - Reflecting this, the 2012 crop and rotation spreadsheets' default nitrogen credit amounts in the Assumptions Worksheet were set to 0 lbs of N per acre.
    - Correspondingly, in the default rotations created in the spreadsheets, adjustments were made following pulse crops that reflect a yield kick for the following cereal crop and protein price premium for the following wheat crop
  - If spreadsheet users want to assign values for nitrogen fixation, the credit amounts (lbs of N/acre) should be changed in the Assumptions Worksheet.
    - In previous versions of the crop and rotation spreadsheet, nitrogen credits were estimated as follows:
      - pea and lentil crops for grain (10 lbs N/acre)

- pea plowdown crops (20 lbs N/acre) \
- cover crops (15 lbs N/acre – a wild guess assuming inclusion of nitrogen fixing plants
- irrigated soybeans (0 lbs N/acre)
- alfalfa (100 lbs N/acre).

- If nitrogen credit amounts are restored in the Assumptions worksheet, the adjustment settings in the default rotations for rotation yield and price benefits should probably be returned to 100% for the cereal crops following pulse and oilseed crops.
- The calculated value of the fixed nitrogen is based on the estimated nitrogen credits and the cost of nitrogen used in fertilizer cost calculations.

Fuel & Lubrication Costs:

- Direct fuel cost estimates are based on the fuel consumption of field operations selected for each crop/year multiplied by the estimated dyed diesel price. The field operations for each crop/year are selected in the Rotation Worksheets.
  - The sources of information for fuel consumption of individual field operations include
    - *Estimating Farm Fuel Requirements,* Colorado State University Extension Service, 2007. (http://www.ext.colostate.edu/PUBS/FARMMGT/05006.html)
    - *Machinery Cost Estimates*, University of Minnesota Extension, June 2009. http://www.extension.umn.edu/distribution/businessmanagement/df6696.pdf .
  - Users can change fuel consumption rates to match their experience.
    - Some modifications of fuel consumption rates were made in response to farmer input.
  - Estimates were made for the fuel consumption of the following field operations: rolling, canola kinking, on-farm silage transportation, and on-farm potato transportation.
  - Combine fuel costs may vary between grain types and yields, for example, more fuel per acre will be required for harvesting irrigated corn compared to irrigated soy beans.
- Fuel costs are based on dyed diesel only, using North Dakota State University Extension Service's estimate for 2012.
  - The spreadsheets do not account for the potential difference in fuel consumption that may exist for a combine to harvest pulse and oilseed crops vs. cereal crops. In general, groundspeeds for pulse and oilseed harvesting is slower than cereal harvesting, resulting in higher fuel use per acre.
- Lubrication costs are estimated to be 15% of fuel costs. This is a percentage used in several other farm production economic analyses. Spreadsheet users can the change lubrication cost estimate factor.

Off-Farm Trucking to Market:

- The cost of off-farm trucking to market is based on an estimated trucking rate ($/loaded mile), weight of crop to be hauled from the farm to market (per acre of production), weight of commodity that can be hauled in a semi trailer (lbs/load), and estimated distance from farm to market.

    - The weight of crop to be hauled (per acre) is based on the yields used to calculate revenue.
    - The weight of the grain that can be hauled in a semi trailer with a pup trailer is presumed to be 69,000 lbs, except for safflower and sunflower (43,700 lbs and 32,200 lbs – due to a lighter test weights than the other crops). For single trailers, the load may weigh approximately 48,000 lbs, except for safflower (30,400 lbs) and sunflower (22,400 lbs).
    - The default load for alfalfa is set to 40,000 lbs/load for local hauls on a semi trailer. For long-distance hauls on double trailers, the load may weigh 60,000 lbs. These load estimates are for square bales.
    - For sugar beets and corn silage, the default load is set to 36,000 lbs/load.
    - The Assumptions Worksheet allows users to enter different distances to market for each crop. Spreadsheet users should update the assumptions to the situation for their operation. Actual distances to market will depend on the proximity of the farm operation to grain buyers of a given commodity.
- The cost of off-farm trucking is also calculated in units of $/bushel, $/ton (alfalfa), and $/cwt (potatoes).
- With fuel and trucking costs in flux, spreadsheet users should adjust the cost per loaded mile estimate to reflect their own projections for future trucking costs. Backhauls may provide an opportunity to reduce trucking costs.

Irrigation Costs:

- The irrigated version of the spreadsheet allows users to factor differences in irrigation costs that are a function of water use. The costs are a function of estimated water use for individual crops. The total irrigation cost is a function of electricity cost, variable water delivery costs (such as water service contracts based on water use), and fixed water delivery costs (such as irrigation district assessments). For fields that are flood irrigated, the electricity usage factor should be set to zero and the water application increased if a component of the water delivery charges are based on consumption (variable).

Operating Interest

- Operating interest is calculated based on the sum of all other direct costs multiplied by an annual interest rate and divided by the fraction of a year that interest accrues.
    - The default estimates use an APR of 6.5%, with interest accruing for nine months. Spreadsheet users should adjust the APR and months of accruing interest to reflect actual conditions for the operation.
    - If an operation is in a strong cash position and does not use operating loans, the APR should be adjusted to match the interest rate the operation receives from farm savings accounts that are used to finance operations. In this situation, the number of months of accruing interest should match the operating cycle (average period from expenditure of operating cash to receiving cash from sale of crop commodities).

Field Operations Time/Labor Requirements

- The Rotation Worksheets and All Crops Worksheet calculate the total hours of field operations (direct labor requirements) per acre for each crop/year in the rotation. The calculations depend on the field operations selected for each crop/year in the Rotation Worksheets and on equipment productivity information entered into the Assumptions Worksheet.
    - In the Assumptions Worksheet, the required hours per acre for each field operation is calculated based on the implement width, operating speed, and operating efficiency. The Assumptions Worksheet also calculates the acres/hr productivity rate for each field operation.
    - The operating speeds and efficiencies used in the initial assumptions are based on information provided in the *Enterprise Crop Budget Generator* spreadsheet created by Duane Griffith of the Montana State University Extension Service. (http://www.montana.edu/softwaredownloads/software/enterprisebudgetor.xls) and "Machinery Cost Estimates", University of Minnesota Extension, June 2009. (http://www.extension.umn.edu/distribution/businessmanagement/df6696.pdf)
        - Spreadsheet users can (and should) adjust implement operating width, speed, and operating efficiency to match the farm operation being analyzed.
        - Harvesting speed of alternative crops will likely be slower than cereal grain crops. However, the spreadsheets do not account for the potential difference in harvesting speed.
- Spreadsheet users can use the field operations calculations to evaluate time requirements for different crops and rotations. These calculations may lead users to consider equipment needs, the possible need to utilize custom farming services, and consider the timing and synchronization of field operations. In appropriate situations, the calculations can potentially be used to compare direct labor costs between alternatives.

Land Rent (All Crops Worksheet & Rotation Worksheets)

Land rent could be a direct cost if all land is rented or it could have relevant differences between crops if rented on a crop share basis that could generate different costs between crops or if rental for high value crops (such as potatoes) commands rental rates higher than other crops. No costs were entered into the spreadsheet, but users have the ability to add such costs.

Custom Hire (All Crops Worksheet & Rotation Worksheets)

Costs for custom operations could be direct costs and can vary between crops. For example, it is not uncommon for farm operations to hire custom spray applicators to desiccate pulse crops prior to harvest. No costs were entered into the spreadsheet, but users have the ability to add such costs.

Machine Rent (All Crops Worksheet & Rotation Worksheets)

Certain crops may involve field operations that require equipment the farm operation does not own, for which it may be more cost effective to rent equipment. An example of this would be rolling equipment for pulse crops. No costs were entered into the spreadsheet, but users have the ability to add such costs.

Direct Labor (All Crops Worksheet & Rotation Worksheets)
Certain crops require more labor. High value crops such as dry beans, sugar beets, and potatoes have considerably higher labor requirements than cereal grain crops. Hay production likely has higher labor requirements than cereal grain production. If the farm operation has the ability to vary its labor expense by hiring temporary labor during peak demand periods, it may be appropriate to include the direct additional labor costs in the economic comparison between crops if it is possible to estimate, segregate, and measure such costs. If a farm operation has sufficient labor resources available with its regular employee base and that employee base is paid fixed monthly or annual amounts, it is less appropriate and meaningful to try to allocate labor costs between crops. Because the labor cost structure and availability of temporary labor varies widely between individual farms and farm types, no costs were entered into the spreadsheet, but users have the ability to add such costs.

Other Direct Costs (All Crops Worksheet & Rotation Worksheets)
Certain crops may involve additional direct costs that vary between crops. An example would be a farm that produces potatoes, along with other crops. Potato production requires significant investment in specialized storage facilities, handling equipment, and dedicated production implements. It is appropriate to allocate these costs on a per acre per year basis, although these costs will be noncash costs, unlike the majority of the costs included in the spreadsheet. Another example would be annual costs related to sugar beet cooperative stock. In the All Crops Worksheet, $225/acre of "Other Direct Costs" was attributed to potato production (for storage equipment and specialty implements); $100/acre was attributed to sugar beet production for annual sugar beet cooperative stock ownership costs ($50/acre) and specialty or additional implements ($50/acre); and $30/acre was attributed to silage harvesting equipment. No other costs were entered into the spreadsheet, but users have the ability to add such costs and will need to add such costs (including Other Direct Costs for potatoes and sugar beets) in Rotation Worksheets.

Discussion on Approach of Economic Comparison: *Return After Direct Costs (Per Acre)*:
The following paragraphs explain concepts that are the basis for the design of the spreadsheet.

The spreadsheet compares the Return After Direct Costs per acre in a comparison that is limited to relevant costs and relevant revenues of different crops, rotations, and farming practices. This approach makes comparisons based on the differences between the alternatives (relevant costs and relevant revenues) and ignores costs and revenues that are the same regardless of the alternatives. Crops such as potatoes may have considerable equipment and storage facility costs that are direct to the crop. Such costs should be amortized over acreage and years in be included the "Other Direct Costs" rows in the All Crops Worksheet and the Rotation Worksheets. Other relevant differences may exist for land rent, custom hire, machine rent, and labor.

With its focus on Returns After Direct Costs Per Acre, it is hoped that the spreadsheet will be a user-friendly tool that can produce comparable analyses for a wide range of users. There can be great variation of indirect and fixed costs between farm operations due to differences in farm size, ownership of farmland and equipment (owned vs. rented), stage of land and equipment debt repayment, age of equipment, equipment replacement strategies, and labor costs (*which can be*

dependent upon the cost of the lifestyles maintained by farm owner-operators and the influence of off-farm income).

Relevant comparisons can ignore fixed costs, so long as fixed costs remain the same for the alternatives being compared. In the overall farm cost structure, indirect costs tend to be fixed costs. For the individual farm, these costs do not vary with the number of acres farmed, unless major expansion or contraction occurs. Fixed costs do not vary with the alternatives being considered by the spreadsheet: crop/rotation selection. Therefore, within the constraints identified, fixed costs are not relevant to the comparison of alternatives.

Including land cost in the comparison can create problems for comparability because of the differences between cash rent, crop share rent, and the "cost" of owned land. The land cost of rented land is a direct cost, whereas the "cost" of owned land is not a direct cost. In terms of relevancy for comparison purposes, the cost of cash-leased land and owned land should not be relevant because the costs should not vary between the alternatives. Land cost for fields rented on a crop share basis will likely vary between alternatives because the cost is based on crop revenue and shared fertilizer cost, which will vary between crops. Other relevant differences could arise if the landlord in a crop share rental arrangement places different limitations on the crop selection and rotation decision.

Adjustment of crop share agreements may be warranted for crop rotations that include pulse crops. A traditional one-third / two-thirds crop share agreement in which the land lord receives one-third of the crop and pays one-third of the fertilizer may result in the landlord receiving most of the gain in the improved economic performance of the land, thereby resulting in insufficient incentive for the tenant to switch to what may be (overall) a more profitable rotation that also is more beneficial to the stewardship of the land. There are key differences in the cost structure of cereal grain production and pulse crop production not addressed in such a traditional crop share agreement. For wheat production, fertilizer costs are high and seed costs modest, while for pulse crop production fertilizer costs are very low and seed costs are very high.

Direct revenue varies between crop types because of the differences in crops' yield and market price and differences in terms of crop insurance policies between crops.

Direct costs will likely differ between crop types. For a given crop, direct costs should not vary greatly <u>on a per acre basis</u>, if best practices are followed and prudent judgment is used.

In traditional accounting and economics terminology, the term "variable costs" includes costs that this guide and the spreadsheet refer to as direct costs. The terminology for "variable costs" was originally (historically) derived to describe costs in a manufacturing setting. Variable costs are costs (such as the cost of raw materials) which vary with the quantity of products being manufactured. The quantity of production (*and therefore variable costs*) is within the manufacturer's control.

- Unlike manufacturers that try to match production with market demand, farms seek to maximize production at the field level to the point of diminishing returns. The quantity of what is harvested on a farm (its production) tends to be much more dependent upon

weather than the farm's investment in inputs (direct costs), which impact yield to varying degrees.

- As such, in the farm setting, what drives "variable costs" is not the quantity of commodity harvested *(which is largely beyond the farm's control)* but rather the number of acres of given crops planted *(something which the farm has control)*. This is an important difference between crop production and traditional manufacturing in the relationship between variable costs and production levels.
- Under the approach used in the spreadsheet, the presumption is that available acreage for a farm is fixed, with the variable factors being crop selection and rotation sequence.

Determination of Return After Direct Costs Per Acre is not a calculation of a total economic return. The calculation of total economic returns is not necessary for comparing alternatives in a short-term to mid-term time horizon. Total economic returns are important for evaluating the economic viability of a farm operation and for making strategic investment or liquidation decisions.

Comparison of the Returns After Direct Costs Per Acre examines alternatives for which operational decisions for change can be made. This analysis focuses on operational decisions (crop selection and rotation design) with the assumption that this is the primary decision area for the individual farm. A major assumption for this approach is that the individual farm will not be making major changes to its fixed cost structure in the short-term to mid-term. Fixed costs generally change as the result of investment and hiring decisions. Equipment purchases or increasing hired labor to enable acreage expansion are examples of changes in fixed cost structure for farm operations.

- In the irrigated spreadsheet (in the All Crops Worksheet), there are three exceptions made with regard to the inclusion of fixed costs in the direct cost comparison – in the default information entered. These are costs related potato production (storage facilities and specialized equipment); sugar beet production (sugar beet cooperative stock costs and specialized equipment); and corn silage production (silage harvesting equipment). If a farm that traditionally produces these crops decides not to grow the crops, the farm will not avoid these costs, with the exception of being able to sell sugar beet quota. Nonetheless, for comparison purposes, not including such costs would result in overstatement of those crops profitability relative to other crops.
- Costs of haying equipment could be handled similarly for farm operations that are dominantly grain operations. However, the underlying assumption in this spreadsheet is that farms comparing forage crops with grain crops are already regularly considering such crops (and consider the ownership or rental of the necessary equipment) as a regular part of the operational decision process.
    - It would be appropriate to make adjustments to factor haying equipment or service costs into the comparisons if the farm in question does not own such equipment (whether it be custom machine hire costs, equipment rental costs, or amortized ownership costs).

Return After Direct Costs Per Acre ***for a given crop*** should not vary greatly between farm operations, assuming that best practices are followed and prudent judgment is used. More variation is likely to exist between farm operations' fixed costs. Both elements of cost involve

strategic decisions. The strategic decisions developed around analysis of Return After Direct Costs seek economic advantage through crop rotation selection (diversification, rotational benefits, niche opportunities). The strategic decisions affecting indirect and fixed costs are focused on achieving economic advantages through efficient use of capital investment and variations in the configuration of capital investment. Both kinds of strategic considerations are important.

Comparison of Rotations Instead of Individual Crops

To achieve comparability, the economic performance of different rotations must be calculated on an average annual return basis. Evaluating rotations also acknowledges that there are constraints to sequences of crops. Diversification of crops within rotations may provide production and market risk diversification. Farming operations can use the spreadsheet to compare traditional rotations (such as wheat-fallow) with rotations designed to achieve higher levels of integrated pest management, rotation-driven yield enhancement, economic diversification, and utilization of nitrogen fixing crops that result in fertilizer cost reduction or yield and quality improvement.

Key concepts / Assumptions

- *Return After Direct Costs as the appropriate measure for comparison:*
    - Crop Revenue – Direct costs = Return After Direct Costs
        - Examples of direct costs include seed, fertilizer, herbicides, insecticides, crop insurance, fuel and lubrication, trucking to market, and related operating interest.
        - Cash rent is a direct cost that is a fixed cost, as is the "cost" of owned land. Crop share rent is a direct cost that varies with yield, crop prices, and fertilizer cost share. In the default rotations, it is assumed that land cost does not vary with the alternative, or is "sunk" and therefore is not relevant to comparing alternatives.
            - The spreadsheet allows land rent to be manually entered as a direct cost for each crop/year in each rotation. It would be appropriate to include this in the analysis if the land rent varies between the crops grown. Between alternatives, a difference in land rent cost will likely exist if land is rented on a crop share basis.
    - Fixed costs are not relevant for comparison because these costs do not vary with the rotation alternatives. Fixed costs tend to be indirect. Although they could be allocated to crops within a rotation, the cost in total would not change.
        - Examples of fixed costs include equipment depreciation, professional services, and in many situations, labor.
        - An exception to this would be inclusion of fixed costs that are dedicated to a particular crop, such as potato storage facilities and specialized equipment.
    - This approach is appropriate for comparing the economic performance for the short-term to mid-term time horizon.
- *The individual farm using the spreadsheet is operating within a relevant range of capacity*: Equipment and labor costs tend to be fixed for a relevant range of acreage, until expansion creates a constraint that must be overcome through addition of capacity (through equipment, labor, or paying for custom field operations). The approach of using

return after direct costs remains valid even if acreage increases (within the relevant range of existing capacity) because fixed costs and indirect costs remain constant.
    - The farm is adequately equipped and does not need to hire additional labor to grow any of the crops being considered.
    - If the situation exists where the cost structure of a farm has labor costs that are identifiable as direct costs (and where the direct labor cost varies with different crops) the spreadsheet allows users to manually enter those costs on a per-acre basis for each crop/year in each rotation. Similarly, if the farm has custom hire costs or machine rental costs that are identifiable as direct costs and vary with the individual crop, the spreadsheet allows those costs to be entered for each crop/year in each rotation.
- *The individual farm using the spreadsheet is a going concern*: The farm is economically viable so that it is capable of staying in business and its owners are committed to continued operations. If there is any question, a total economic return should be calculated to determining whether the farm operation is a going concern.
- *Sunk costs*: Costs incurred for past decisions "are sunk" and should not have undue influence future decisions. What is done is done; planning for the future should focus on what provides the best returns in the future. Many indirect costs or fixed costs are sunk costs.
- *Assumption that government payments are not significantly different between options:* Government payments are omitted from this analysis since government payments tend to be somewhat fixed regardless of planting decision (with the exception of LDP payments) and have been declining over the last two decades (*and therefore are of less significance at the "per-acre" level, with the acknowledgement of their importance at the farm-level in contribution to net income in an environment of declining margins and increasingly larger farms*). It is difficult to evaluate the role government payments will play (if any) in the comparative economics of different crops and rotations.
    - In the short term, the ACRE program appears capable of influencing crop selection decisions or at least the profitability attributed to a crop.
    - The Conservation Stewardship Program provides the opportunity for incentive payments for farms incorporating diverse rotations and may be an additional factor that will drive increased acreages of pulse crops and cover crops.
- *Consideration for variability (of numerous factors: yields, commodity prices, direct costs).* The spreadsheet models the economic performance of crops and crop rotations with single-value assumptions. Improvements to the spreadsheet introduced in 2011 allow users to do some sensitivity testing of key variables, particularly in the All Crops Worksheet. The potential for revenue from crop insurance is also included in the spreadsheets, but users need to make sure and update the estimates entered with real insurable yields, insured prices, and insurable revenue that is available to insurable units.
    - The default values entered into the Assumptions Worksheet are based on averages, information for given points in time, standard commodity quality, and rough estimates for the future that are applied throughout the time horizon being considered. In reality, the numbers entered for each assumption have a range of possible values, with different probabilities of occurrence. Variables (such as yield) have different coefficients of variability for different crops and crop sequences.

        - An ideal economic model would account for variability and probability and be supported by perfect information specific to the farm being analyzed. The ideal economic model would assess risk or the impact of variability on calculated economic outcomes. However, incorporating mechanisms to account for variability into the spreadsheet add complexity to the spreadsheet design, make the spreadsheet less user-friendly, and interfere with the objective of making the spreadsheet highly flexible.
        - An ideal economic model would not limit the consideration of variability to commodity yields and prices. In addition to commodity yield and price, an ideal economic model would consider the variability of significant direct costs in the comparison of alternatives.
        - The spreadsheet is meant to be used as a first step in the consideration of alternatives in crop rotation. Farmers constantly face changing conditions that affect numerous variables. Farmers have to reach decisions without complete information. Ultimately, farmers must utilize available information, observation, and personal experience to perform their own personal calculus *(that considers risk and variability)* to reach decisions. Experience, risk tolerance, economic situation, growing conditions, and the individual farm's agricultural capacity vary - *which is why different farms adopt different farming strategies*.
        - It is expected that most farmers' decision processes, alternatives crops or rotations must provide economic returns that exceed (as opposed to equaling) the status quo (cereal – fallow rotation) before they will consider making changes. It is assumed that in determining the minimum amount of "premium" required to stimulate change, the individual farmer applies "personal calculus" that accounts for variability and risk.
            - In other words, each individual farmer considers the following questions:
                - To what degree do I believe the numbers calculated?
                - How likely is the projected outcome?
                - How much more effort will the alternative require?
                - How will the alternative affect the rest of the operation?
                - If the alternative does not turn out, how much worse off will the farm be than if it stayed with the status quo?
                - Considering everything, is the potential economic benefit high enough to take on the risk?
    - One way for spreadsheet users to examine the impact of variability is to make multiple models that show best case estimates, worst case estimates, and average/expected case estimates for the most significant variables (such as commodity price, yield, fertilizer cost, herbicide cost, and trucking cost). Making multiple models will not address the probability of outcomes, but will help estimate the potential range of outcomes.
- *The spreadsheet does not allow users to vary the prices of commodities or direct costs with time.* This limitation simplifies the spreadsheet design and improves ease of use, but requires that spreadsheet users enter what they believe will be representative prices for

the timeframe under consideration. Spreadsheet users should consider this limitation in their personal calculus of variability and risk.

- It is presumptuous to consider the default values of prices and input costs entered into the spreadsheet to be representative of future prices and costs. It would seem equally presumptuous to attempt to predict future prices of commodities and direct costs on a year-by-year basis. As witnessed in 2007 – 2008 and 2010 - 2011, even expert industry analysts can be significantly off in predicting prices of commodities and direct costs.
    - Numerous trends will affect commodity prices, direct costs and agricultural practices in the future. Examples of these trends include: population growth, improved global standard of living, increased integration of global economies, leaner inventory management that is more susceptible to supply shortages *(and depresses prices when surpluses occur)*, increased global energy consumption, declining global oil and gas reserves, increased economic and humanitarian impact of catastrophic weather events, observed changes in the global climate that may point to changing weather patterns, potential for greenhouse gas markets and regulations to impact agriculture, increasing intensity and sophistication of agriculture in second and third world nations, declining rates of reproduction in first world countries, demographic bubbles, increased concern over food safety and nutrition, advances in biotechnology and other agricultural technologies, corporate determination to promulgate biotechnology, loss of agricultural land to nonagricultural use, conflict over natural resources, and weakening in the United States' position as the world economic leader *(which can directly impacts exchange rates and interest rates).*

References & Resources:

PRICE INFORMATION

Statpub.com http://www.statpub.com/stat/prices/spotbid.html

Saskatchewan Pulse Growers Pulse Market Reports: (over 2 years of monthly reports):
http://www.saskpulse.com/producer/selling/index.php?page=106

Alberta Weekly Grain Price Report
http://www.agric.gov.ab.ca/economic/stats/wkgrain.html
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd6248 (archive)

USDA-AMS
Weekly National Bean, Pea & Lentil Market Review http://www.ams.usda.gov/mnreports/gl_gr851.txt
Dry Edible Bean Daily Grower Bids http://www.ams.usda.gov/mnreports/gl_gr510.txt
Bean Market News http://www.ams.usda.gov/mnreports/lswbean.pdf
Annual Bean Market News Review http://www.ams.usda.gov/mnreports/lsaba.pdf
Kansas City Commodity Invitation of Bids http://www.ams.usda.gov/mnreports/lsbcccoffers.pdf
Kansas City Commodity Awarded Bids http://www.ams.usda.gov/mnreports/lsbcccawards.pdf
State Hay Archives
http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateW&navID=RN2HayL1&rightNav1=RN2HayL1&topNav=&leftNav=MarketNewsAndTransportationData&page=SearchHayReports&resultType=&acct=lsmn
USDA Agriculture Marketing Service Market News and Transportation Data
http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateB&navID=MarketNewsAndTransportationData&leftNav=MarketNewsAndTransportationData&page=LSMarketNewsPage

USDA Montana Regional Cereal Grain Prices
Current Prices http://wbc.agr.mt.gov/Producers/pricing_current.html
Historic Prices http://wbc.agr.mt.gov/Producers/pricing_historical_mt.html

USDA National Agriculture Statistics Service - Montana Prices Received, Monthly & Marketing Year Averages and Other Economic Data http://www.nass.usda.gov/Statistics_by_State/Montana/Publications/econtoc.htm

Intercontinental Exchange (Canola Futures) https://www.theice.com/homepage.jhtml

Pulse Canada Feed Pea Benchmark (Subscribe to Feed Pea Benchmark Weekly Report via the following website)
http://www.pulsecanada.com/benchmark

Agriculture Agri-Food Canada
Pulse & Specialty Crops Outlook http://www.agr.gc.ca/mad-dam/index_e.php?s1=pubs&s2=spec&page=intro
Grains & Oilseeds Outlook http://www.agr.gc.ca/pol/mad-dam/index_e.php?s1=pubs&s2=go-co
Market Analysis Division Publications http://www.agr.gc.ca/pol/mad-dam/index_e.php?s1=pubs&page=intro

Government of Saskatchewan - Agriculture Market Trends http://www.agriculture.gov.sk.ca/MarketTrends

North Dakota State University Extension Crop Budgets:
http://www.ag.ndsu.nodak.edu/aginfo/farmmgmt/cropbudget.htm (archive)
http://www.ag.ndsu.edu/pubs/ecguides.html (2012)

INDUSTRY INFORMATION RESOURCES

Northern Pulse Growers Association http://www.northernpulse.com/
U.S. Dry Pea & Lentil Council http://www.pea-lentil.com/
Saskatchewan Pulse Growers http://www.saskpulse.com/
Alberta Pulse Growers http://www.pulse.ab.ca/
Pulse Canada http://www.pulsecanada.com/

Canola Council http://www.canola-council.org/
Northern Canola Growers Association http://www.northerncanola.com/
Saskatchewan Mustard Development Commission http://www.saskmustard.ca/grower/index.html
Flax Council of Canada http://www.flaxcouncil.ca/english/index.jsp
Ameriflax http://www.ameriflax.com

Agriculture Agri-Food Canada – Pulse Outlook & Oilseeds Outlook
http://www.agr.gc.ca/mad-dam/index_e.php?s1=pubs&s2=spec&page=intro
http://www.agr.gc.ca/pol/mad-dam/index_e.php?s1=pubs&s2=go-co

NDSU, "Pulse Crop Marketing Guide", August 2006 www.ag.ndsu.edu/pubs/agecon/market/ec1277.pdf

Saskatchewan Pulse Growers Pulse Market Reports: (over 2 years of monthly reports):
http://www.saskpulse.com/producer/selling/index.php?page=106

Pulse Canada "Canadian Feed Peas Industry Guide", (2003, Dave Hickling, Ph.D.)
http://www.cigi.ca/pdfs/Pea%20Guide%202003.pdf

FAO's FAOSTAT database (international production & trade):
http://faostat.fao.org/site/339/default.aspx (production)
http://faostat.fao.org/site/537/default.aspx (trade)

CROP PRODUCTION REFERENCES & RESOURCES:

Alfalfa:
"*Alfalfa*", August 1998, Kansas Rural Center Sustainable Agriculture Management Guide
http://www.kansasruralcenter.org/publications/alfalfa.pdf

"*Establishing a Successful Alfalfa Crop*", MontGuide MT 200504 AG, issued May 2005, Montana State University Extension Service http://msuextension.org/publications/AgandNaturalResources/MT200504AG.pdf

"*Production of Rain-Fed Alfalfa*", Montana State University Extension Service, 2007
http://ag.montana.edu/carc/extenpub/07cashproductionrain.pdf

Camelina:
"Camelina Production in Montana", Montana State University Extension Service: Montguide MT200701AG, revised March 2008, http://msuextension.org/publications/AgandNaturalResources/MT200701Ag.pdf

Canola:
"Canola Production Field Guide", North Dakota State University Extension Service, February 2005
www.ag.ndsu.edu/pubs/plantsci/crops/a1280.pdf

North Dakota State University ProCrop Canola Menu http://www.ag.ndsu.edu/procrop/rps/index.htm

Chickpeas:
"Growing Chickpea in the Northern Great Plains", Montana State University Extension Service; MontGuide MT 200204 AG, issued March 2002 http://msuextension.org/publications/AgandNaturalResources/MT200204AG.pdf

"Growing Chickpeas (Garbanzo Beans) in Montana", Montana State University Integrated Pest Management Center, Last Update: November 16, 2001 http://ipm.montana.edu/MPIN/Cropfiles/ChickGarb.htm

Saskatchewan Pulse Production Manual – Chickpea www.saskpulse.com/media/pdfs/ppm-chickpea.pdf

"Pulse Crops In Alberta", Alberta Agriculture, Food and Rural Development, 1999. ($35)
order from: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex17

Dry Beans:
"*Dry Bean Production Guide*", A-1133, July 1997. North Dakota State University Extension Service.
http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/a1133-1.htm

Flax:
"*Flaxseed Production in Montana*", Montana State University Integrated Pest Management Center / USDA Pest Management Centers / NSF Center for Integrated Pest Management
http://ipm.montana.edu/MPIN/Cropfiles/flaxseed.htm

"Oilseed Flax: A Montana Specialty Crop", Montana State University Extension Service, MontGuide MT 8907:
http://cropandsoil.oregonstate.edu/bioenergy/sites/default/files/FlaxOilseed-A-Montana-Specialty-Crop.pdf

North Dakota State University ProCrop Flax Menu http://www.ag.ndsu.edu/procrop/flx/index.htm

Lentils:
"*Growing Lentils in Montana*", MontGuide MT 199615 AG, issued June 2001, Montana State University Extension Service http://msuextension.org/publications/AgandNaturalResources/MT199615AG.pdf

"*Lentil Production in Montana*" Last Update: September 13, 2001, Montana State University Integrated Pest Management Center / USDA Pest Management Centers / NSF Center for Integrated Pest Management
http://ipm.montana.edu/MPIN/Cropfiles/Lentil.htm

North Dakota State University ProCrop Lentil Menu http://www.ag.ndsu.edu/procrop/lnt/index.htm

Saskatchewan Pulse Production Manual – Lentil www.saskpulse.com/media/pdfs/ppm-lentil.pdf

"Pulse Crops In Alberta", Alberta Agriculture, Food and Rural Development, 1999. ($35)
order from: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex17

Mustard:
"*Crop Profile for Mustard in Montana*", Prepared Jan., 2002 Montana State University Integrated Pest Management Center / USDA Pest Management Centers / NSF Center for Integrated Pest Management
http://www.ipmcenters.org/CropProfiles/docs/MTmustard.html

"Tame Mustard Production", Revised June 2007, North Dakota State University, Publication A-935
http://www.ag.ndsu.edu/pubs/plantsci/crops/a935w.htm

North Dakota State University ProCrop Mustard Menu http://www.ag.ndsu.edu/procrop/mst/index.htm

CROP PRODUCTION REFERENCES & RESOURCES: *(continued)*

Mustard:
"Growing Mustard" Saskatchewan Mustard Development Commission (set of mustard growing and harvesting documents) http://www.saskmustard.ca/grower/growing/index.html

"Mustard Production & Management", Manitoba Agriculture, Food and Rural Initiatives (online mustard production practices information and links)
http://www.gov.mb.ca/agriculture/crops/specialcrops/big01s01.html#field

Peas:
"*Crop Profile for Dry Peas in Montana*", Prepared Feb, 2002 Montana State University Integrated Pest Management Center / USDA Pest Management Centers / NSF Center for Integrated Pest Management,
http://www.ipmcenters.org/CropProfiles/docs/MTdrypea.html

"*Growing Dry Pea in Montana*", MontGuide MT 200502 AG, issued May 2005, Montana State University Extension Service http://msuextension.org/publications/AgandNaturalResources/MT200502AG.pdf

North Dakota State University ProCrop Pea Menu http://www.ag.ndsu.edu/procrop/pea/index.htm

Saskatchewan Pulse Production Manual – Field Pea www.saskpulse.com/media/pdfs/ppm-field-pea.pdf

"Pulse Crops In Alberta", Alberta Agriculture, Food and Rural Development, 1999. ($35)
order from: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex17

Potatoes:
"*Growing Irrigated Potatoes*", AE-1040 (Revised) March 1999, North Dakota State University Extension Service.
http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/ae1040w.htm

Safflower:
"*Safflower Production*" A-870 (Revised), August 2007, North Dakota State University Extension Service
http://www.ag.ndsu.edu/pubs/plantsci/crops/a870w.htm

"*Crop Profile for Safflower Production in South Dakota*", December 2001, South Dakota State University / USDA Pest Management Centers / NSF Center for Integrated Pest Management
http://www.ipmcenters.org/cropprofiles/docs/SDsafflower.html

"*Fertilizing Safflower*", SF-727 (Revised), October 1992, North Dakota State University Extension Service
http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf727w.htm

Soybeans:
"*Nitrogen and Soybeans*" (a 2009 presentation) Matt Ruark, Assistant Professor of Soil Science, University of Wisconsin Extension http://www.soils.wisc.edu/extension/area/2009/Nitrogen_And_Soybeans_Ruark.pdf

OTHER CROP PRODUCTION RESOURCES & INFORMATION

"North Dakota Weed Control Guide", W-253, January 2011, North Dakota State University Extension Service
http://www.ag.ndsu.edu/weeds/weed-control-guides/nd-weed-control-guide-1

Discussion of Herbicide Carryover: http://www.ag.ndsu.edu/weeds/weed-control-guides/nd-weed-control-guide-1/wcg-files/15-CO.pdf

"Integrated Strategies for Managing Agricultural Weeds", Montguide MT 200601 AG, July 2006, Montana State University Extension Service http://msuextension.org/publications/AgandNaturalResources/MT200601AG.pdf

"2012 North Dakota Fungicide Guide", North Dakota State University Extension Service
http://www.ag.ndsu.edu/extplantpath/publications-newsletters/fungicides

"Seed Treatment for Disease Control", PP-447, Revised, March 2000, North Dakota State University Extension Service http://www.ag.ndsu.edu/pubs/plantsci/crops/pp447w.htm

"Quick Guide to Seed Treatment Fungicides", PP-447, North Dakota State University Extension Service
http://www.ag.ndsu.edu/pubs/plantsci/crops/pp447.pdf

"North Dakota Field Crop Insect Management Guide", December 2011, North Dakota State University Extension Service
http://www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm
http://www.ag.ndsu.nodak.edu/aginfo/entomology/entupdates/ICG_11/00_Insect_Guide_2011.pdf

"Fertilizer Guidelines for Montana Crops", Publication # EB 161, March 2005, Montana State University Extension Service http://msuextension.org/publications/AgandNaturalResources/EB0161.pdf

Montana State University Extension Service - Fertilizer Economics webpage
http://landresources.montana.edu/soilfertility/fertilizereconomics.htm

"*Chapter 5.35 Nutrient Uptake and Removal by Field Crops – Western Canada*", Manitoba Forage Council Forage & Grassland Manual, referenced to the Canadian Fertilizer Institute, January, 2001.
http://www.mbforagecouncil.mb.ca/resources/forage-grassland-manual/5-forage-fertility/535-nutrient-uptake-and-removal-by-field-crops-western-canada/

USDA Natural Resources Conservation Service Crop Nutrient Tool http://plants.usda.gov/npk/main

"*Nutrient Uptake and Removal*", USDA Natural Resources Conservation Service
http://www.nrcs.usda.gov/technical/NRI/pubs/nlapp1a.html

"*Nutrient Removal Values for Field and Forage Crops*", FS014, October 2003, Rutgers Cooperative Research & Extension http://njveg.rutgers.edu/assets/pdfs/soil/fs014-jhNutrient_Removal_Values_for_Field_and_Forage_Crops.FS014.pdf

"*Soybean N Credits*" Cornell University http://nmsp.cals.cornell.edu/publications/factsheets/factsheet30.pdf

"*Nitrogen Credits from Sod*", Cornell University
http://nmsp.cals.cornell.edu/publications/tables/N_credits_sods.pdf

"*Crop Rotations for Increased Productivity*" EB-48 (Revised), January 1998, North Dakota State University Extension Service http://www.ag.ndsu.edu/pubs/plantsci/crops/eb48-1.htm

North Dakota Crop Sequence Calculator, USDA Agriculture Research Service – Mandan
http://www.ars.usda.gov/Services/docs.htm?docid=10791

OTHER CROP PRODUCTION RESOURCES & INFORMATION *(continued)*

"*Energy Requirements for Various Tillage- Planting Systems*", and Purdue University Cooperative Extension Service Publication NCR-202-W, July 1983 http://www.ces.purdue.edu/extmedia/NCR/NCR-202-W.html

"Conserving Fuel on the Farm", Cathy Svejkovsky, National Center for Appropriate Technology, 2007
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=303

"*Estimating Farm Fuel Requirements*", Colorado State University Extension Farm Management Online Fact Sheets No. 5.006, updated December 20, 2007 http://www.ext.colostate.edu/PUBS/FARMMGT/05006.html

"*Machinery Cost Estimates*", University of Minnesota Extension, June 2009
http://www.extension.umn.edu/distribution/businessmanagement/df6696.pdf

"*Enterprise Crop Budget Generator*", Montana State University Extension, last modified April 18, 2006
http://www.montana.edu/softwaredownloads/software/enterprisebudgetor.xls

USDA Risk Management Agency – Federal Crop Insurance Corporation
Summary of Business Database http://www3.rma.usda.gov/apps/sob/stateCountyCrop.cfm
Cost Estimator (2011 onward) https://ewebapp.rma.usda.gov/apps/costestimator/
Premium Calculator (2010 and earlier) http://www3.rma.usda.gov/apps/premcalc/
Actuarial Information http://webapp.rma.usda.gov/apps/ActuarialInformationBrowser/

USDA National Agriculture Statistics Service - Montana County Yield Statistics
http://www.nass.usda.gov/Statistics_by_State/Montana/index.asp (MT County Level Data – Crops)